REMARKS

Claims 12 through 29 (previously withdrawn) have now been canceled without prejudice.

In the final rejection mailed on March 24, 2003, the Examiner maintained the rejection of claims 1 through 11 as obvious over Dufrane et al. (5,031,538) in view of Taylor et al. (3,291,664). Reconsideration of this rejection is requested for the following reasons.

The Examiner argued that:

> *Dufrane et al. discloses a delay element that comprises barium sulfate, silicon, and red lead. The binder of sodium carboxymethyl cellulose is not disclosed.*
>
> *Taylor et al. discloses the use of up to 5% sodium carboxymethyl cellulose with a delay composition.*
>
> *It would have been obvious to one having ordinary skill in the art at the time the invention was made to use the binder as taught by Taylor with the delay composition of Dufrane since Taylor suggests that the binder is useful in delay compositions.*

The Examiner seems to have overlooked the fact that the main claims of the present application do not simply require a composition comprising barium sulfate, silicon and red lead, but rather requires the red lead to be present in an amount in the range of 3 to 15% by weight of the composition. Dufrane et al. does not disclose this (or any) range. Applicant believes that this feature of the invention is unobvious from Dufrane et al. either with our without Taylor et al. This is the reason why Applicant, in the prior response, tried to draw attention to the teaching of Dufrane alone, i.e. to address the incorrect assumptions that the Examiner was making about the relevance of this reference when combining the teaching of this reference with Taylor.

Moreover, Applicant was forced by PTO rules and practice in early proceedings to select a single species for further examination. Applicant selected a single composition most likely to be commercialized. This included carboxymethyl cellulose in a small amount. However, the description of the invention, as well as the main claims and the first three Examples, make it clear that carboxymethyl cellulose is a preferred but not essential ingredient. When this particular composition is found to be patentable, as Applicant believes it will, Applicant intends to argue that claim 1 as it currently stands is patentable in its broad scope. Applicant accordingly wishes to show that the present invention is patentable over the prior art even without the requirement for carboxymethyl cellulose. Applicant therefore wishes to demonstrate that the present invention does not rely for patentability on the presence of

carboxymethly cellulose (although this is an important secondary invention), and that claim 1 in its broadest form is patentable over the known prior art.

As stated in the introduction of the present application, one stimulus for the present invention was the use of "rigid" metals in confinement elements for delay compositions. Such metals have a greater heat capacity than the conventional lead. This means that more heat is drawn from the composition as it ignites, and can cause a lack of reliability in the combustion process. An obvious solution to this approach would be to develop a composition with a higher heat output during combustion, e.g. by increasing the fuel component (silicon) and oxidant (e.g. red lead). Instead, the present invention relies on the use of unusually low amounts of red lead, i.e. in the percentage range stated above. As stated on page 8, starting at line 5 from the bottom:

> *Although the amount of red lead is much less than previously employed in compositions of this kind (e.g. as disclosed in U.S. Patent 4,419,154), it has been surprisingly found that the amount is sufficient to impart suitable robustness and reliability of combustion to the composition when used in rigid metal confinement elements, without increasing the burn rate unacceptably for long delay uses.*

Hence the problem facing the inventors of this invention, was how to make a delay composition that would satisfy the apparently conflicting requirements of (a) generating a more reliable combustion when in contact with a rigid metal, without (b) increasing the burn rate so much that the composition would be unsuitable as a long delay composition (a faster burn rate creates a need for a longer delay element, and there is a practical limit to the length of a delay element of about four inches). Merely adding more fuel (silicon) and oxidant (such as red lead) would generate more heat, thus making the combustion more stable, but it would result in a rapid-burning composition. The solution to this problem was to reduce the amount of red lead (a strong oxidant - see page 4, lines 1 and 2). As noted on page 9, paragraph [0031]:

> *the red lead appears to react with silicon at a low ignition temperature (about 500°C) and generates heat which facilitates the barium sulfate/silicon combustion reaction whose ignition temperature is high (about 1200°).*

This is an unexpected result that Applicant believes is not at all obvious from the prior art, including Dufrane. It is therefore Applicant's position that the combination of Dufrane and Taylor is not relevant because, among other reasons, Dufrane itself does not disclose the claimed invention in the manner stated by the Examiner. In Applicant's view, the teaching of Taylor does not overcome the deficiencies of disclosure of Dufrane because the deficiency of Dufrane is not merely confined to a lack of disclosure of carboxymethy cellulose. Additionally, it is the Applicant's position that Taylor does not anyway teach the features stated by the Examiner. However, if Dufrane is deficient in that it does not disclose Applicant's unobvious claimed range of 3 to 15% by wt. for the red lead, the teaching of Taylor is immaterial and reliance on this reference does not make a proper combination.

Discussing Dufrane, the Examiner stated in the final action:

> *With regard to the Dufrane reference, Applicant argues that Dufrane does not disclose a three component delay composition. This is clearly not the case. In column 4, lines 10-15, Dufrane says that any known delay composition may be used and indicates that a mixture of silicon, red lead oxide, and barium sulfate is a possibility. The only optimizing would be with regard to the amounts of each of the three components and one of ordinary skill in the art would certainly know to vary the fuel and oxidizers to obtain different rates of burning and delay.*

First of all, Applicant did not argue in the previous response that Dufrane does not disclose a three component delay composition. On page three of the response, line 1, Applicant stated:

> *Consequently, Dufrane et al. discloses mixtures of silicon, red lead and barium sulfate...*

Secondly, Applicant disagrees that the present invention only requires optimizing of the proportions of these constituents. As noted above, the reduction of conventional proportions of red lead (an oxidant) when desiring greater heat output is counterintuitive. It is to be noted that Dufrane states that the delay composition may be of any known in the art - but compositions having the proportion of red lead required if the present invention were not known in the art at the date of the Dufrane patent. If the Examiner is arguing that Dufrane suggests the use of all possible proportions of the three ingredients (which is an extreme position that Applicant would deny - after all, some would presumably not even be functional), then the present invention is still inventive because it amounts to an inventive selection and not a mere optimization.

A main requirement of a selection invention is unexpected results. The Examples in the application show that this requirement is satisfied for the present invention. First of all, Table 1 on page 12 of the present application shows that the timing delay increases when red lead is first introduced (3% compared to 0%), so it is not acting just as an accelerant to the combustion process as might be expected. Indeed, Table 1 shows that at contents up 9%, red lead decreases the average time of delay compared to a composition having zero percent red lead. Again, red lead is not acting as an accelerant. On the other hand, a considerable improvement in reliability (Coefficient of Variation) is achieved compared to the composition having no red lead.

Figures 9 and 10 of the application clearly show that, over the range of 3 to 15% for read lead, the delay timings and the Coefficient of Variation remain quite stable (reach a plateau), which are essential considerations for the present invention. If these values varied significantly within the range, it would make the compositions very sensitive to content variations, and it would be necessary to measure the proportions of the ingredients very precisely, possibly more precisely than is compatible with mass-production. Figures 9 and 10 also show that the delay timing and CV are optimal for the invention.

Another unexpected advantage is that the compositions of the invention are more resistant to "shock-stop", that is the tendency of a composition to stop burning when subjected to shock waves from adjacent explosions. This is explained and exemplified on the lower half of page 22. The contribution of red lead to this property is not predictable and certainly it is not clear why a reduction of red lead compared to that normally used would have this effect.

These results show that, at the concentrations of red lead employed in the present invention, there is a some phenomenon occurring that is not self-evident. This is discussed in the description of the present application at page 8, bottom five lines, to page 9, end of first paragraph. The effect observed by lowering the proportion of red lead is counter-intuitive and cannot be explained by accepted theory.

In fact, Examples 1, 2 and 3 (at least) and the related Figs. show that the presence of small amounts of red lead leads to better ignitability, reduced shock-stop and higher robustness of propagation, with little or no adverse effect on the burn rate of the composition.

As noted above, the concept that Dufrane, in mentioning compositions of silicon, barium sulfate and red lead, discloses all proportions of such ingredients is not credible because it must surely include compositions that would not be useful (e.g. compositions containing very small amounts of the silicon as the fuel component). What then does Dufrane reasonably suggest in the way of such compositions? Dufrane states Column 4, lines 10 and 11:

> *The delay compositions may be of any known in the art, for example ...*

Dufrane is not itself concerned with inventing new delay compositions - such compositions are merely mentioned in passing during the description of another invention (an ignition buffer). Dufrane issued in 1991 and was filed in 1990, so as noted above, Dufrane was contemplating delay compositions of the kind known at those dates. Applicant believes that there are no examples of compositions falling within the claims of the present application either prior to or subsequent to these dates, and the Examiner has found no disclosures of this kind. Dufrane cannot therefore be taken as a disclosure of the present invention, and it does not make the present invention obvious (either in combination with Taylor or alone) for the reasons given above. Reconsideration of the rejection is therefore requested.

Regarding the teaching of Taylor, the Examiner stated:

> *Applicant argues that the Taylor reference does not disclose the same composition. The Taylor reference is not being used to show the same delay composition but merely the suggestion that sodium carboxymethyl cellulose can be used with a delay composition regardless of how the composition is prepared.*

In noting that Taylor discloses a different type of composition, Applicant was making the point that, if Taylor shows that sodium carboxymethyl cellulose has the effect of causing delay (in this regard, see the comments below), it does so only with respect to primary explosives, not with respect to delay compositions as such. Therefore, there is no reason why a person of ordinary skill in the art would combine the teaching of this patent with that of Dufrane et al., since Dufrane et al. is concerned (in passing) with delay compositions as such. What is relevant to one class of composition (primary explosives) is not necessarily relevant to another class of composition (delay compositions based on silicon).

The Examiner continued:

> *Also, in column 3, lines 57-67, Taylor indicates that the addition of sodium carboxymethyl cellulose gives very effective control of the rate of burning which is certainly a goal with any delay composition.*

This part of Taylor (column 3, lines 57 to 69) reads as follows:

> *Carboxymethyl cellulose is often effective when present in the solution in a quantity as low as 0.01% of the weight of the explosive substance and for initiatory purposes up to 1% is generally used, a generally useful range being 0.1-1%. Larger amounts, however, up to 3% and exceptionally up to 5% may be used especially for the delay purposes. The addition of carboxymethyl cellulose gives very effective control of the rate of burning by regulating the crystal growth as well as the inertness of the explosive. Generally speaking, as the amount of carboxymethyl cellulose employed is increased bulk density will increase to a maximum, the optimum amount depending upon the particular primary explosive used.*

This passage clearly links control of the burning rate to regulation of the crystal growth (during precipitation) as well as inertness. The delay compositions of the present invention are not produced by precipitation of crystals formed in solution, so it is not at all clear that the effect noted by Taylor et al. would be obtained in delay compositions. Taylor says that the optimum amount depends on the particular "primary explosive" used. Clearly, Taylor is talking only about primary explosives. These are not delay compositions. Delay compositions are slow burning fuse-like materials that cause a delay because of the extensive time it takes a column of the material to burn from one end to the other. Primary explosives are essentially instantly-detonating compositions, where there is virtually no delay in burning through the composition. There is nothing disclosed in Taylor et al. that would be instructive to a person of ordinary skill in the art looking for improvements in delay compositions containing red lead and silicon, as disclosed by Dufrane.

The Examiner went on to say that:

> *In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e. rigid metals) are not recited in the claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims.*

The point that Applicant was trying to make was that the only type of metal mentioned by Dufrane for the confinement element is lead (Column 4, line 10). The present invention is not designed for operation with confinement elements made of lead. A person skilled in the art reading Dufrane, which is not specifically concerned with confinement elements made of rigid metals, would have no motivation to take this disclosure into account when looking for compositions intended for use with rigid metals, or at most, would only find direction to use conventional delay compositions as mentioned by Dufrane.

For these reasons, it is believed that the rejection of the claims should be withdrawn and the application allowed.

The undersigned would appreciate an opportunity to discuss these issues with the Examiner before the Examiner makes a decision on this case. The Examiner is therefore invited to contact the undersigned at the telephone number provided below. It is believed that this may facilitate the further prosecution of this case.

Respectfully submitted,

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August 21, 2003